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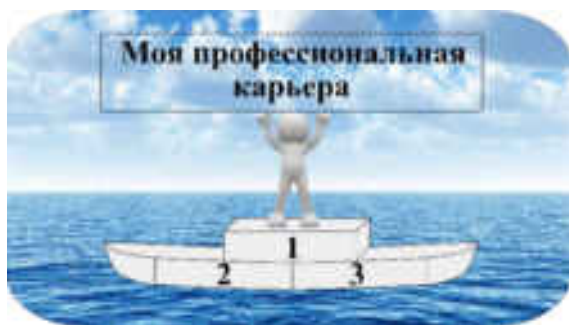


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**Международный научно-образовательный электронный журнал
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Содержит научные статьи отечественных и зарубежных авторов по экономическим, техническим, философским, юридическим и другим наукам.

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Название публикации: «PHARMACOGENETIC EVALUATION OF TEUCRIUM
GROWING IN TURKMENISTAN»

***Abstract:** Teucrium is a large and diverse genus of flowering plants belonging to the family Lamiaceae, which comprises about 300 species distributed in temperate and subtropical regions of the world. The name Teucrium derives from the ancient king Teucer, who was the founder of Troy and a renowned herbalist. Teucrium species are commonly known as germanders, and they have various morphological features, such as square stems, opposite leaves, bilabiate flowers, and four nutlets.*

***Keywords:** Teucrium scorodoides, Soxlet extractions, Pharmacognostic.*

Teucrium scordioides occurs on rocky environment such as Little and Big Balkan, south-west Kopetdag, Hojagala, Ereshdag, Ajydere, Sunt, Yoldere, Saywan, Nohur. Being located in the center of Kopetdag Mountains gives the province its special landscape which feature hot summers and mild winters and fairly high annual precipitations (about 400 mm) mostly in form of rain, although snow is not rare. The climate of the region is semi-arid, and the soil texture is mostly sandy loam and silt loam [1].

Teucrium species have been used in traditional medicine for various purposes, such as treating digestive disorders, inflammation, infections, diabetes, and cancer. The medicinal properties of Teucrium species are attributed to their rich phytochemical content, which includes terpenoids, flavonoids, phenolic acids, iridoids, and alkaloids. These phytochemicals exhibit diverse biological activities, such as antioxidant, anti-inflammatory, antimicrobial, antidiabetic, anticancer, analgesic, antispasmodic, and neuroprotective effects [1].

However, the pharmacognostic properties of Teucrium species have not been systematically reviewed and summarized. Pharmacognosy is the study of the physical, chemical, biochemical, and biological properties of natural products from plants,

animals, and microorganisms. Pharmacognostic evaluation is essential for the identification, authentication, quality control, standardization, and safety assessment of medicinal plants and their products [2].

EXPERIMENTAL PART in this work we extracting the valuable bioactive compounds from *Teucrium scordioides* (*T. scordioides*) requires careful consideration of the target molecules and appropriate techniques. Here are some key points to consider: Choice of solvent: we match the solvent polarity to the target compounds. Methanol, ethanol, and water are suitable for extracting diverse polar compounds like flavonoids, phenolic acids, and tannins. For less polar constituents like diterpenes, consider non-polar solvents like hexane or dichloromethane.

Soxhlet extraction is one of the most popular techniques for extraction of analytes from solid materials. For extraction, we need 50g of plant material (Figure 1).



Figure 1. 50g of *Teucrium scordioides* measured in digital scale.

Soxhlet extraction is used when the desired compound has a limited solubility in a solvent, and the impurity is insoluble in that solvent. It allows for unmonitored and unmanaged operation while efficiently recycling a small amount of solvent to dissolve a larger amount of material.



Figure 2. Extraction by Soxhlet extractor.

Extraction. The air-dried, powdered aerial parts (40 g) were extracted with cyclohexane (2 x 400 mL) during three days (two times, successively). After filtration, plant material was dried and extracted with dichloromethane and methanol (2 x 400 mL) using the same procedure. The solvent 51 was evaporated under low pressure and dried to obtain of C_6H_{12} (0.39 g), CH_2Cl_2 (0.81 g) and MeOH extracts (2.94 g) (Figure 2).

Then extracted compound is filtered by filter paper.



Figure 3. Filtering the extracted solution.

Analysis and pharmacogonstic evaluation.

Spectrophotometric analysis is done after the extraction (Figure 4).



Figure 4. Sample for spectrophotometric analysis.

Our results are completely in accordance with previous researches because the distribution of methoxy flavones was dominant in *Teucrium* species, while diosmetin was found especially in species of section *Scordioides*. Also, luteolin- and apigenin-7-glucosides were found in almost all tested *Teucrium* species, diosmetin-7-rutinoside in some species of section *Scordioides* and *Scordioides*. Luteolin-7-rutinoside was very frequent in all *Teucrium* species. Vicenin-2 has not been found in the tested methanol extract of *T. scordioides*, which was also the characteristic of section *Scordioides*.

Cytotoxicity The cytotoxicity of *T. scordioides* on malignant cell lines has not been studied before. Concerning the presence of furanoid diterpenoids and their cytotoxicity, we tested activity against MDA-MB-361 (estrogen-dependant) and MDA-MB-453 (estrogen-nondependant) breast cancer cell lines. Kandouz et al. (2010) have shown the inhibition of cell invasion and motility of human prostate cancer cells through different molecular pathways by *T. scordioides* extract recently. The essential oils from four *Teucrium* species were cytotoxic against colon adenocarcinoma CACO-2, amelanotic C32 and large lung carcinoma COR-123. The results were presented in Table 4. Cyclohexane and dichlormetane extract possessed high activity on estrogen-dependant breast cancer cell lines with the $IC_{50}=130.33\pm0.1\text{g/ml}$ and $IC_{50}=189.89\pm3.99\text{g/ml}$, respectively. Dichlormethane extract was more effective against estrogen-nondependant cells ($IC_{50}=130.33 \pm 0.1 \text{ g/ml}$). High sensitivity of both estrogen receptor positive (ER+) and estrogen receptor negative (ER-) cell lines to cyclohexane and dichlormethane extracts suggesting the presence of the compounds

which antiproliferative action is ER dependant. The methanol extract of *T. scordioides* was not cytotoxic against tested

Cytotoxicity of *Teucrium scordioides* extracts against MDA-MB-361 and MDA-MB-453 (IC₅₀ g/ml $\pm$ S. D.).

Extract	Cytotoxicity	
	MDA-MB-361	MDA-MB-453
Cyclohexane extract	130.33 $\pm$ 0.1	367.28 $\pm$ 11.82
Dichlormethane extract	189.89 $\pm$ 3.99	131.01 $\pm$ 0.1
Methanol extract	>500	371.55 $\pm$ 5.28
Cis-DDR	17.35 $\pm$ 0.27	3.96 $\pm$ 0.45

Antimicrobial activity Antibacterial and antifungal activities of the cyclohexane, dichlormethane and methanol extracts of *T. scordioides* (100 mg/ml) were evaluating by agar diffusion method on selected gram-positive and gram negative bacteria and fungi: *Staphylococcus aureus* (ATCC 25923), *Staphylococcus epidermidis* (ATCC 12228), *Micrococcus luteus* (ATCC 10240), *Enterococcus faecalis* (ATCC 29212), *Bacillus subtilis* (ATCC 6633BB), *Bacillus cereus* (ATCC11778), *Escherichia coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC 27853), *Klebsiella pneumoniae* (NCIMB 9111) and *Candida albicans* (ATCC 10259). Each assay in this experiment was repeated twice. Ampicillin (10 g/tbl), amikacin (10 g/tbl), and nystatin (100 U/tbl) served as positive controls (Table 4).

HPLC analysis. The analysis of HPLC chromatograms by comparison of the retention times and UV spectra of selected picks with standard substances have shown the presence of luteolin, apigenin, diosmetin, luteolin-7-O-glucoside, luteolin-7-O-rutinoside and diosmetin-7-O-glycoside in the methanol extract.

Antioxidative activities of *Teucrium scordioides* Traditionally, the administration of aqueous extracts of *Teucrium* plants is most frequently used method to treat several disorders, including cardiovascular diseases and disorders related to oxidative stress. Thus, the main objective of the present work was to evaluate the antioxidant and antihyperlipidemic activities, quantify the key families of secondary metabolites, and determine the chemical composition of the aqueous extract of *T. scordioides* (AETT).

DPPH free radical scavenging test. 2,2-Diphenyl-1-picrylhydrazil (DPPH) radical scavenging activity was determined according to the method described by Elbouny et al. (2022). The results were compared to those obtained for quercetin, which was used as a control antioxidant. The test was performed in triplicate, and the percentage of inhibition (I %) of the DPPH free radical by test extracts was calculated as follows:

$$I = \frac{A_{\text{Control}} - A_{\text{Sample}}}{A_{\text{Control}}} \times 100$$

where I% = percentage of DPPH inhibition, A Control = absorbance of negative control; A Sample = absorbance of the sample.

ABTS free radical scavenging test. AETT was tested for free radical scavenging activity against 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid (ABTS) radical, as described by Pukalskas et al. (2002). The percentage of inhibition was calculated in the same manner as for DPPH, and the average of the concentrations responsible for 50% of its inhibition (IC₅₀) was determined.

Ferric-reducing antioxidant power (FRAP) test. This test is based on the reduction of ferric iron (Fe³⁺) to ferrous iron (Fe²⁺). The ability of AETT to reduce iron was determined by following the protocol established by Oyaizu (1986), with the modifications described by El-Guourrami et al. (2003). The concentration that converted 50% of Fe³⁺ to Fe²⁺ was determined [3].

CONCLUSION

Chemical Composition. *Teucrium scorodoides* is a rich source of various bioactive compounds, including phenolic acids, flavonoids, and diterpenes. These compounds are responsible for the plant's diverse pharmacological activities. Phenolic acids, such as rosmarinic acid and caffeic acid, exhibit antioxidant and anti-inflammatory properties. Flavonoids, such as apigenin and luteolin, possess anti-microbial, anti-inflammatory, and anti-cancer properties. Diterpenes, such as scordolide A and scordolide B, exhibit anti-inflammatory and cytotoxic properties.

Antioxidant Activity. *Teucrium scorodoides* exhibits antioxidant activity due to its high content of phenolic compounds. These compounds scavenge free radicals, preventing oxidative damage to cells and tissues. The antioxidant activity of *Teucrium scorodoides* has been shown to protect against various oxidative stress-induced conditions, such as atherosclerosis, cancer, and neurodegenerative diseases.

Cytotoxic Activity. *Teucrium scorodoides* has demonstrated cytotoxic activity against various cancer cell lines. The plant's diterpene compounds, such as scordolide A and scordolide B, have been shown to induce apoptosis and inhibit cell proliferation in cancer cells.

Antimicrobial Activity. *Teucrium scorodoides* has demonstrated significant antimicrobial activity against a wide range of microorganisms, including Gram-positive and Gram-negative bacteria, fungi, and viruses. The plant's extracts have been shown to inhibit the growth of various pathogenic bacteria, including *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. Additionally, *Teucrium scorodoides* has exhibited antifungal activity against *Candida albicans* and *Trichophyton mentagrophytes*. Furthermore, the plant has shown antiviral activity against herpes simplex virus type 1 and influenza virus A.

Teucrium scorodoides is a valuable medicinal plant with a long history of traditional use and promising therapeutic potential. Its diverse chemical composition, including a range of phenolic compounds, flavonoids, and diterpenes, contributes to its broad spectrum of pharmacological activities. The plant possesses significant antimicrobial activity against a variety of Gram-positive and Gram-negative bacteria, as well as fungi and viruses. Additionally, *Teucrium scorodoides* exhibits anti-inflammatory, antioxidant, and cytotoxic properties. These findings suggest that the plant has promising therapeutic potential for a range of conditions, including infectious diseases, inflammation, and cancer. Further research is warranted to elucidate the mechanisms of action of *Teucrium scorodoides* and to develop effective therapeutic formulations.

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